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Bay Scallop Habitat Suitability Models: Predictions over Space and Time



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Introduction

Although often thought of as a denizen of sea grass beds, the bay scallop, *Argopecten irradians*, is found in a wide variety of habitats (Figure 1). In order to aid managers in seeding and habitat restoration efforts, we developed a model of habitat suitability for this commercially important species. We then used the model to predict abundance in future years as well as in a different location.

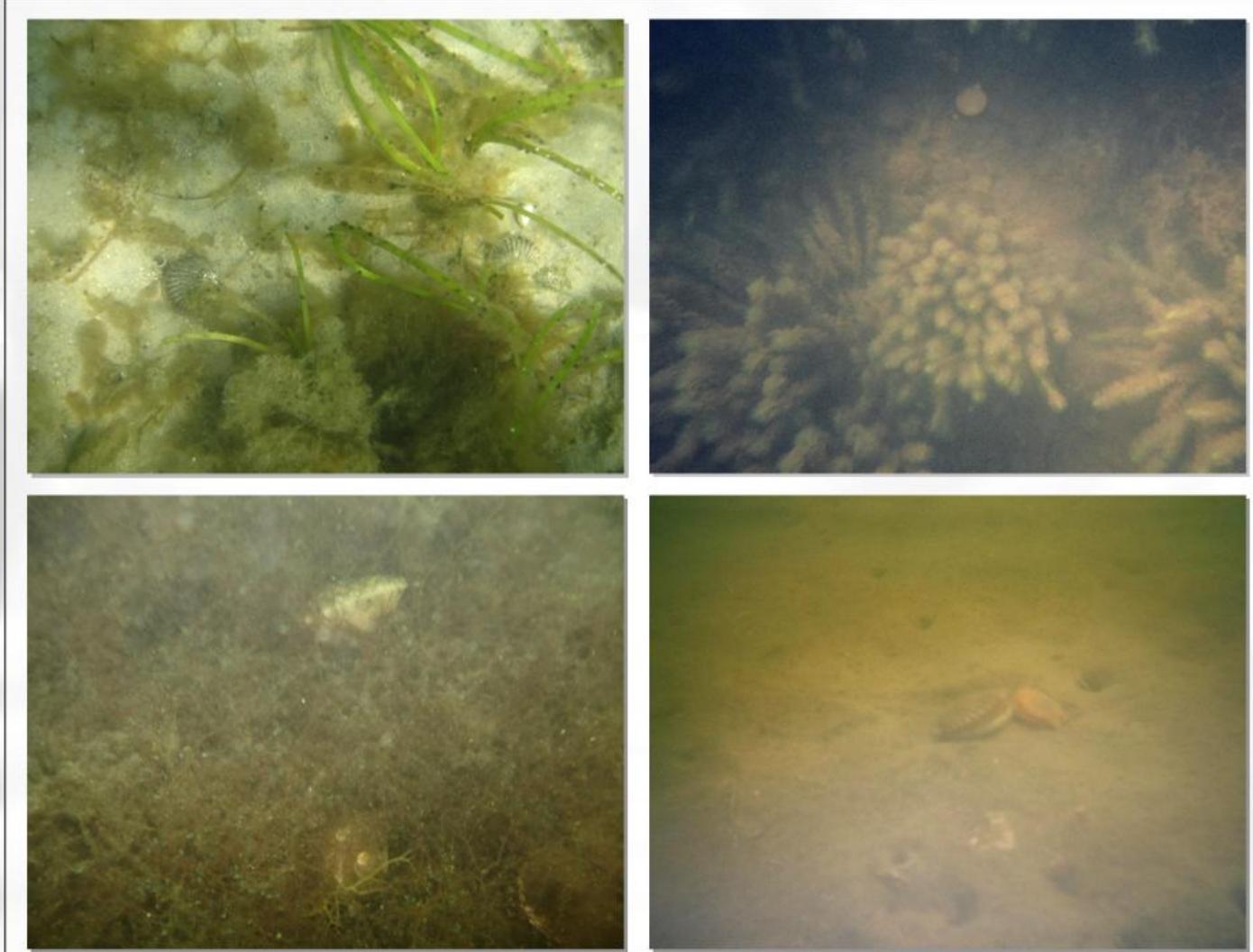


Figure 1. Scallops occupy a wide range of habitats, including sea grass beds, algae, and bare sediment.

Methods

A scallop habitat survey conducted in Lagoon Pond, MA in September, 2005 using a stratified random sampling design (Figure 2). At each sampling point divers collected scallops along two parallel 25 m transects. Indicators of habitat quality were measured by divers and boat crew.

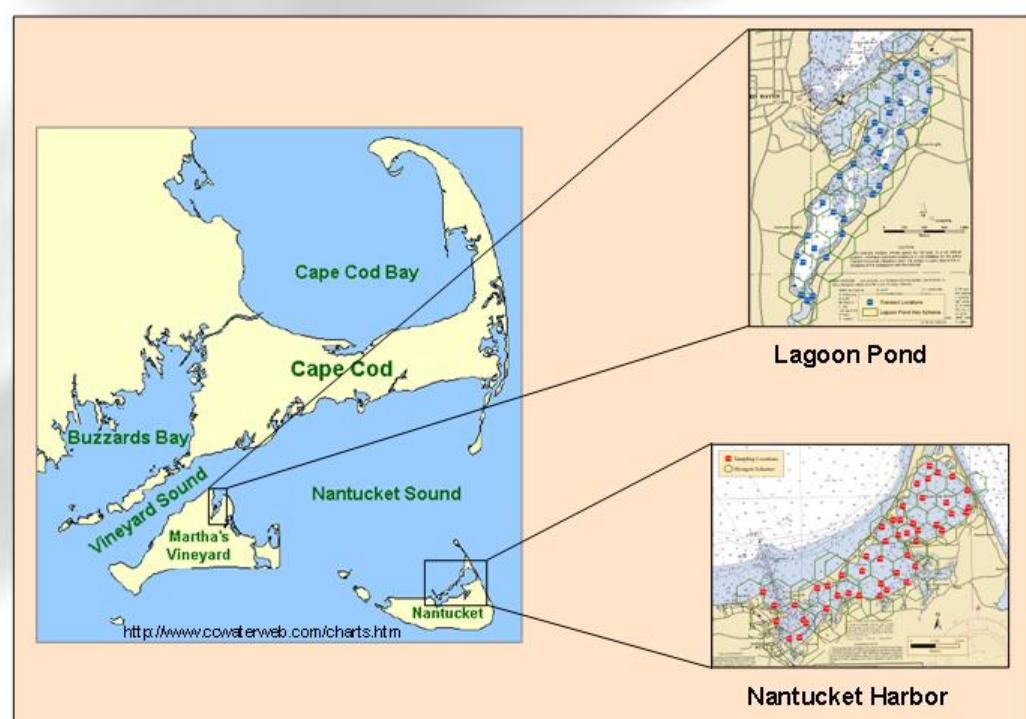


Figure 2. The location of the Lagoon Pond and Nantucket Harbor study sites, showing the stratified random sampling designs

Based on preliminary analysis and correlation among some variables, the following variables were used in the final analysis:

- Depth
- bottom temperature
- bottom salinity
- bottom dissolved oxygen
- secchi depth
- percent fine sediment
- total plant cover (algae + eelgrass)

Multiple linear regression was used to relate the habitat variables to log-transformed scallop abundance. All possible variable combinations were examined, and a final model produced using model averaging based on Akaike weights. As juveniles and adults may have different habitat requirements, separate models were constructed for these life history stages. These models were then used to predict scallop abundance in Lagoon Pond and Nantucket Harbor in 2006.

Results

Using multiple linear regression and model averaging, models were produced relating log juvenile and adult scallop abundance to habitat attributes (Table 1).

Table 1. Regression coefficients of the juvenile and adult scallop habitat models. Models are based on the 2005 Lagoon Pond survey.

Life History Stage	Intercept	Depth (m)	Temp (°C)	Salinity (ppt)	DO (mg l⁻¹)	Fine Sediment (%)	Secchi Depth (m)	Total Plant Cover (%)
Juvenile	2.781	-0.010	0.004	-0.049	-0.028	1.341	-0.054	0.006
Adult	2.478	-0.038	0.019	-0.027	-0.054	0.009	-0.013	0.025

The models above predicted scallop abundance moderately well for both juveniles and adults, explaining about half the variation in abundance (Figure 3).

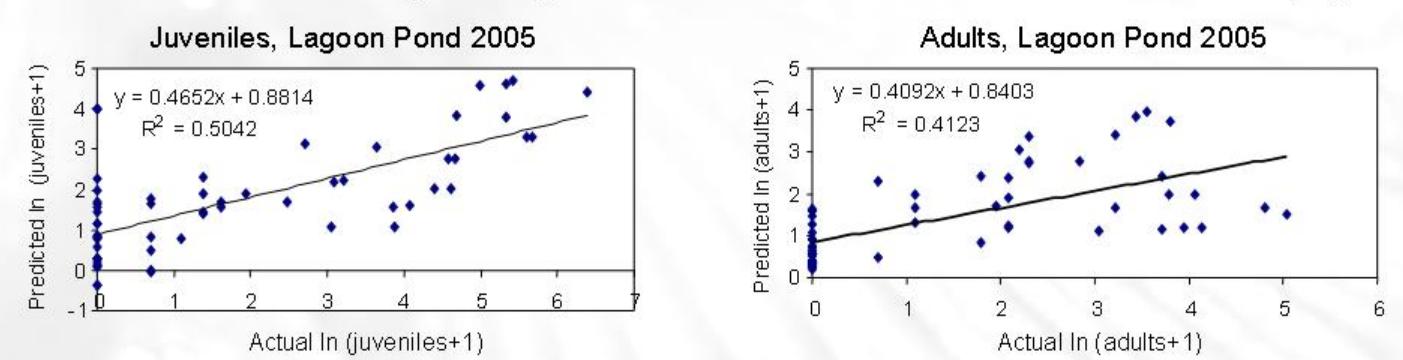


Figure 3. Predictions of the 2005 Lagoon Pond models for Lagoon Pond 2005

When the 2005 Lagoon Pond models are used to predict 2006 abundance in the same water body, they predict adult abundance moderately well but fail to predict juvenile abundance (Figure 4).

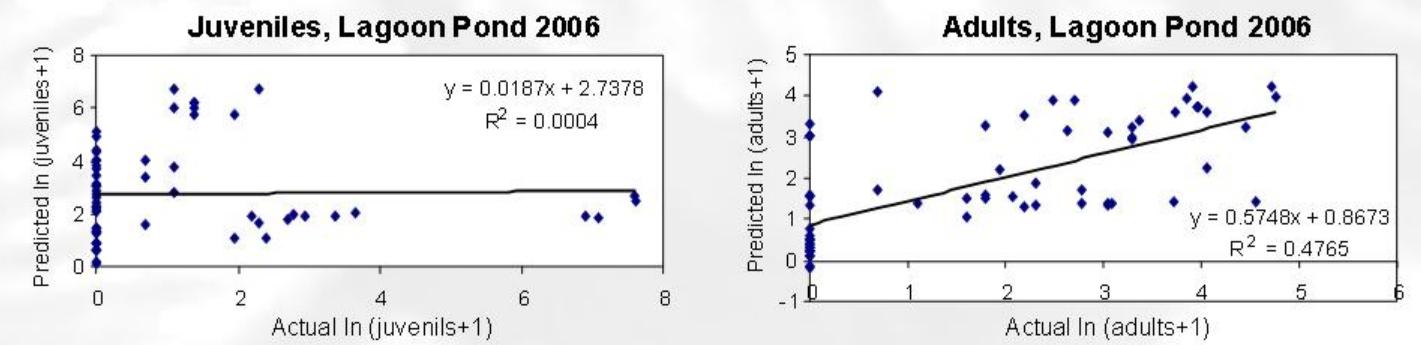


Figure 4. Predictions of the 2005 Lagoon Pond models for Lagoon Pond 2006

When the 2005 Lagoon Pond models are used to predict 2006 abundance for Nantucket, they fail for both juveniles and adults (Figure 5).

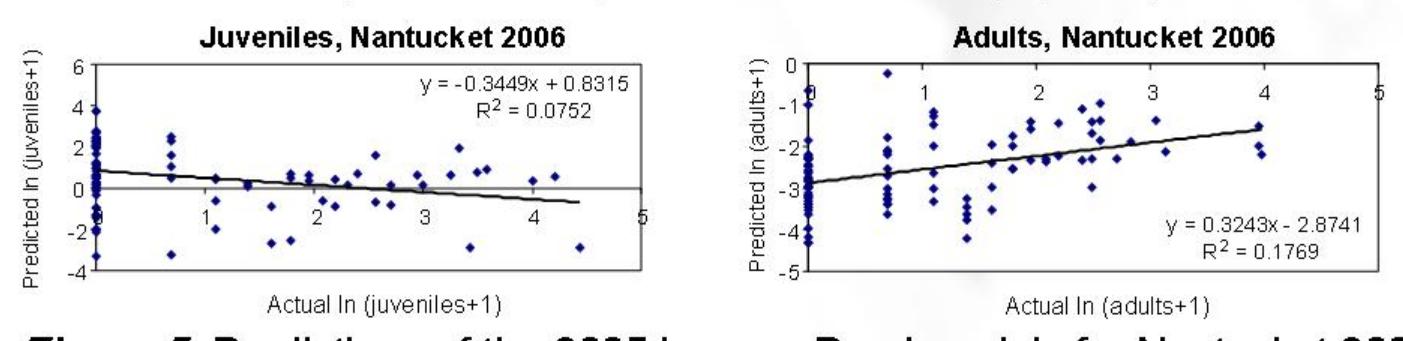


Figure 5. Predictions of the 2005 Lagoon Pond models for Nantucket 2006

Discussion

The models developed for Lagoon Pond in 2005 explained about half the variation in abundance for both adult and juvenile scallops. Other factors that may account for the other half of the variation include predation, larval supply, fishing, and management efforts.

When the 2005 Lagoon Pond models are used to predict 2006 abundance in the same water body, they predict adult abundance moderately well but fail to predict juvenile abundance. This suggests something other than habitat is controlling juvenile abundance. We suspect currents and larval supply may be important factors determining juvenile abundance.

When the 2005 Lagoon Pond models are used to predict 2006 abundance in Nantucket harbor, they fail to predict both juvenile and adult abundance. It is possible that scallops occupy slightly different habitat in Nantucket Harbor and Lagoon Pond. Another possibility is that the range of some habitat variables is greater in Nantucket Harbor than Lagoon Pond, forcing the models to make predictions outside the variable ranges for which they were developed. A third possibility is that something other than habitat (e.g. fishing, predation, larval supply) is the major factor controlling scallop abundance in Nantucket. A fourth possibility is that the abundance is related to habitat in a non-linear fashion, and non-linear models are necessary to explain this relationship.

Future work will include developing separate habitat models for Nantucket, and using different modeling techniques to relate scallop abundance to habitat.